NOAA Technical Report: Wave Exposure Indices for Shoreline Impacted by Deepwater Horizon Shoreline Oiling

Zachary Nixon

Research Planning, Inc.
1121 Park Street, Columbia, SC 29201
Phone: 803-256-7322
znixon@researchplanning.com

Abstract

Wave exposure is one of the principle physical processes controlling shoreline morphology and ecology, and quantification of relative wave exposure is thus of primary importance in evaluating shoreline oiling behavior and ecological impact during oil spills. This work describes a suite of relative wave exposure indices modified from previous algorithms intended to facilitate understanding of wind-wave exposure along the shorelines of the northern Gulf of Mexico during and after the Deepwater Horizon (DWH) oil spill. We also compared these index values with physical wave model output and shoreline habitat data. We first generated estimates of shoreline fetch (over-water distance) from eight cardinal directions for each open water grid cell on a 25 meter grid. We then compiled long-term wind climate statistics for four different coastal NOAA National Buoy Data Center buoys across the study area. We finally generated two different Relative Exposure Index (REI) values. The mean-based Relative Exposure Index (REI_m) is based on fetch, average wind speed, and the proportion of time the wind was observed from a given direction. The exceedance-based Relative Exposure Index (REI_e) is based on fetch and the proportion of time the wind from a given direction exceeded a given threshold. We found that both mean- and exceedance wind speed based relative wave exposure wave indices were significantly and monotonically related to modeled significant wave height and wave power for nearshore areas in separate studies from Alabama, Florida and Louisiana, though these relationships were not always linear. We also found significant evidence that the values of both indices varied by shoreline morphology, particularly between beaches and emergent wetland shorelines. These results imply that such indices can serve as useful and efficient proxies for wave energy incident upon shorelines for the purposes of oil spill response and injury assessment, in the absence of *in-situ* nearshore wave measurement or numerical wave modeling.

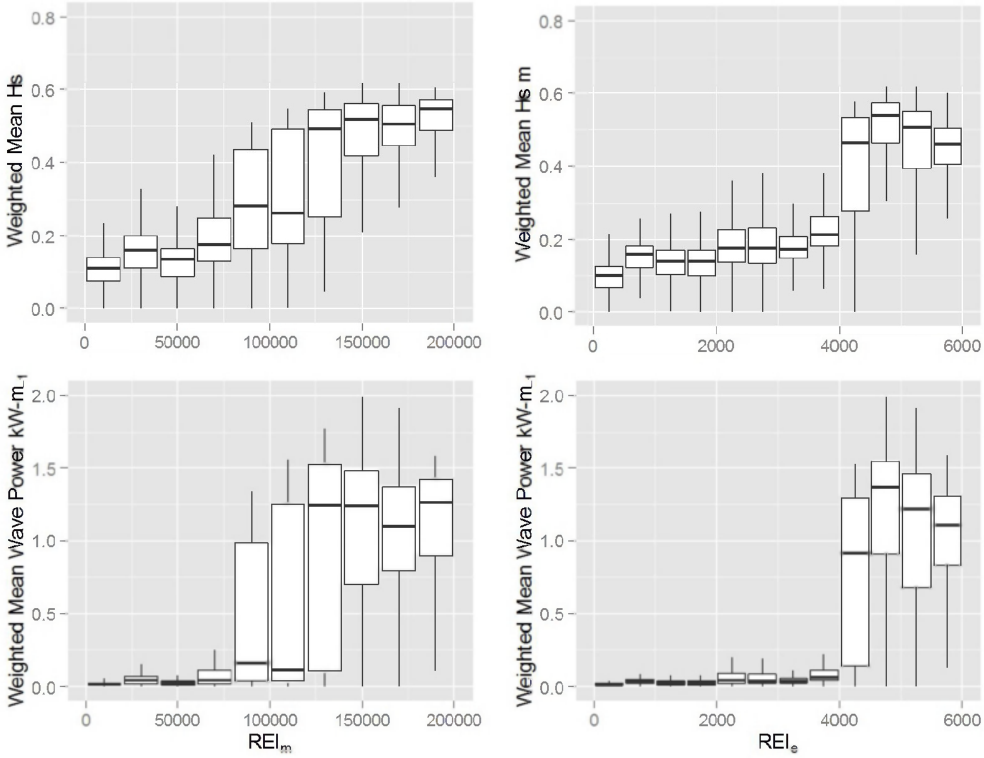

FIGURE 1. Boxplots of values of modeled weighted average significant wave height (H_s) in m and non-directional wave power in kW-m^{-1} by binned values of REI_e and REI_m for exposure index model cells within 1 km of shoreline.